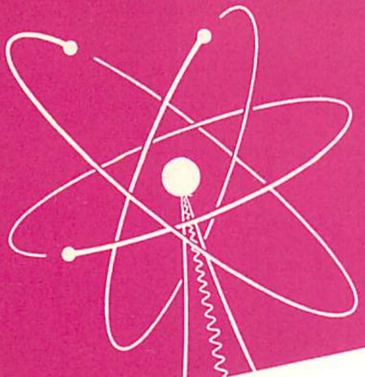

PROJECTION RECEIVER ADJUSTMENTS

Lesson T4E-2A

DeVRY Technical Institute
4141 W. Belmont Ave., Chicago 41, Illinois
Formerly DeFOREST'S TRAINING, INC.

T4E-2A

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ELECTRONICS TELEVISION
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4141 Belmont Ave.
Chicago 41, Illinois

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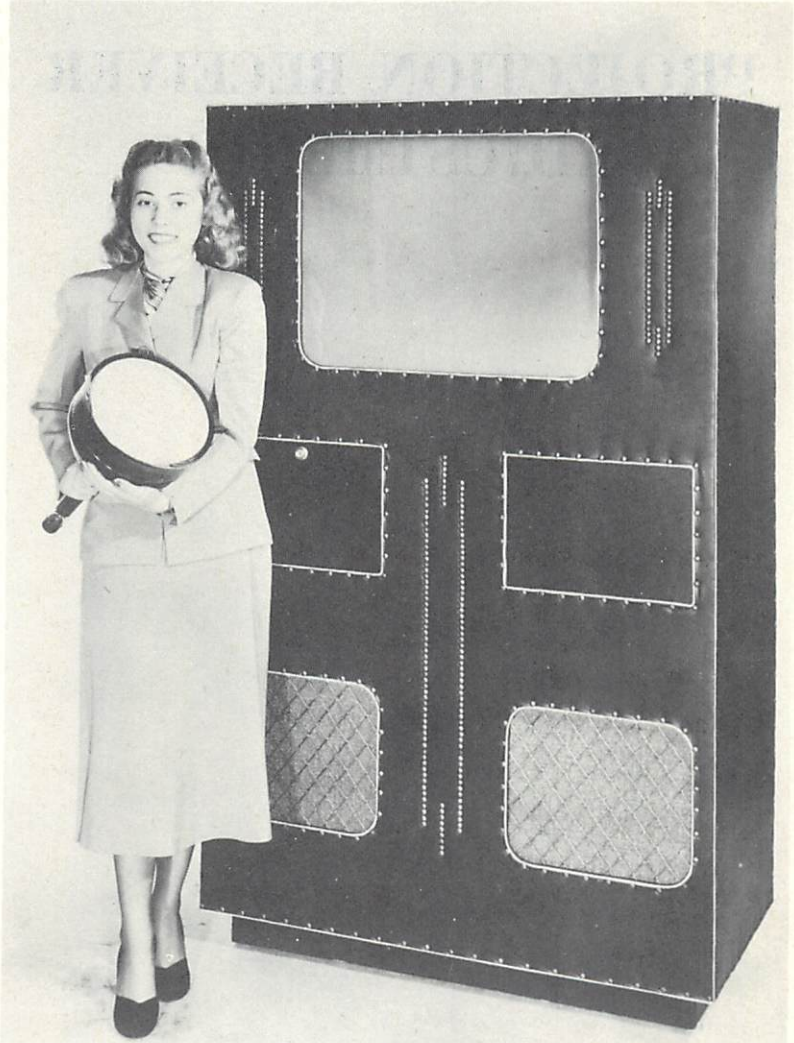

The industrial type projection receivers provide entertainment for large groups. As shown, the receiver uses a large screen projection tube.

Courtesy U. S. Television Mfg. Corp.

PROJECTION RECEIVER ADJUSTMENTS

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A great deal of the joy of life consists in doing perfectly, or at least to the best of one's ability, everything which he attempts to do. There is a sense of satisfaction, a pride in surveying such a work—a work which is rounded, full, exact, complete in all its parts—which the superficial man, who leaves his work in a slovenly, slipshod, half-finished condition, can never know. It is this conscientious completeness which turns work into art. The smallest thing, well done, becomes artistic.

—William Mathews

PROJECTION RECEIVER ADJUSTMENTS

In a previous lesson, the methods which are employed to increase the size of the received image in the projection type television receivers were explained. Although the signal, sync, and deflection circuits are the same in both the projection and direct-view types of receivers, the projection receiver high voltage supply is designed to provide the considerably higher anode potential which is necessary to produce the relatively high screen intensity needed. Here again, the circuits are similar basically in the two types of receivers; just one or more additional stages are employed in the voltage-multiplier section of the projection receiver high voltage supply.

From an electric standpoint, the troubles which develop and the servicing procedures employed are the same for projection receivers as for direct view units, and having been covered previously, will not be repeated now. The essential difference between the two receiver types lies in the fact that the projection unit contains some type of optical system for enlarging the image.

Since mechanical and optical troubles may develop in this system, this lesson is devoted to the adjustment, cleaning, and replacement of the various elements of the optical systems, as well as pointing out important details in the servicing of the high voltage supplies.

HIGH VOLTAGE SUPPLY CIRCUITS

In some home type projection receivers, the high voltage supply consists of the common flyback circuit arrangement with a voltage-multiplier which contains three or four rectifier tubes and associated capacitors to produce an output in the neighborhood of 27 to 30 kv. A second common arrangement consists of a voltage-multiplier driven by a pulse generating circuit which is not associated with the receiver deflection circuits.

A schematic diagram of a pulse type high voltage supply is shown in Figure 1. Here, tube V_1 operates as a blocking oscillator, V_2 as a pulse amplifier, and tubes V_3, V_4, and V_5 are the rectifiers in the voltage-multiplier circuit. As indicated by the dashed line, the high voltage transformer T_2 and the voltage-multiplier components are enclosed in an oil filled, sealed can.

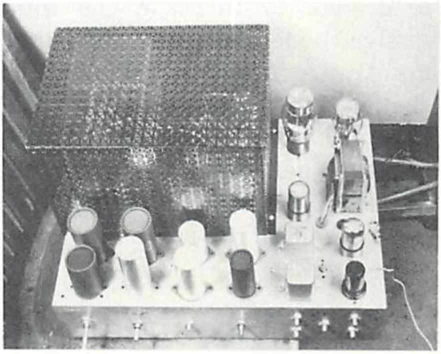
The dual-triode V_6 operates as a high voltage cutoff device to prevent a horizontal or vertical line being burned on the screen of picture tube V_7 in the event of failure in either of the receiver deflection circuits.

Briefly the action of the circuit of Figure 1 is as follows. The blocking oscillator produces a 1000 cycle pulse which is amplified by V_2 and applied to the primary winding of transformer T_2. As the entire winding of T_2 serves as the high voltage secondary, the pulse is stepped up in voltage and applied to tube V_3 and capacitor C_9 which form the first stage of the voltage-multiplier. C_9 is charged to the peak of the voltage pulse across the secondary of T_2, and so capacitors C_{10} and C_{11} are each charged to twice this peak voltage.

C_9 and C_{11} are connected in series, as shown, and thus their charges add to provide the total indicated output of 25 kv. Heater windings on T_2 provide current for the rectifier tube heaters. The pulse voltage from a fifth winding is rectified by the diode of tube V_1, and filtered by capacitors C_8 and C_7 and resistor R_8 to apply a fixed negative bias to the grid of V_2.

Since the frequency must be approximately correct to obtain the proper heater currents in rectifier tubes V_3, V_4, and V_5, a vernier adjustment of the blocking oscillator frequency is provided by variable capacitor C_6.

As indicated in Figure 1, the receiver horizontal deflection voltage is applied through capacitor C_{12} to the grid of one section of dual-triode V_6, and the vertical deflection voltage is applied through capacitor C_{13} to the grid of the other section. These respective voltages cause grid current such that the grid leak voltages developed across grid resistors R_{10} and R_{11} are high enough to cut off the plate currents of tube V_6.



The top view of the high voltage and deflection circuit chassis used in projection type receivers.

Courtesy Television Assembly Co.

Thus, the only voltage drop across resistor R_{12} is due to the picture tube beam current. That is, with V_6 cutoff, the greatest part of the picture tube operating bias is the negative voltage applied from the slider on potentiometer P through resistors R_{14}, R_{15}, R_{16}, R_{17}, and peaking coil L to the grid of V_7.

Should either deflection circuit fail, the grid leak bias across R_{10}

or R_{11} will be reduced or disappear entirely to permit conduction of the associated triode section of V_6. The resulting plate current produces a voltage drop of the indicated polarity across cathode resistor R_{12}, and thus biases the picture tube cathode positive with respect to ground.

In series in the grid-cathode circuit of picture tube V_7, this bias will add to the operating grid bias to increase the total grid-cathode voltage and thus greatly reduce the intensity of the electron beam. This protection is highly important because if either deflection circuit should fail, the full intensity beam will burn a hole in the screen material very quickly.

SERVICING THE HIGH VOLTAGE SUPPLY

Symptoms such as no light on the screen, reduced picture brightness, and increased raster width and height indicate trouble in the high voltage supply, or in other receiver circuits upon which proper operation of the high voltage supply depends. First, the usual preliminary check of the power cord plug and fuses should be made. Also, any other connecting plugs and the picture tube socket should be checked to see that they are not disconnected. If no such obvious faults are visible, then a neon bulb or arc tests may be used to locate the faulty section, and voltage and resistance tests made to locate the defect in receivers employing the flyback type of high voltage supply.

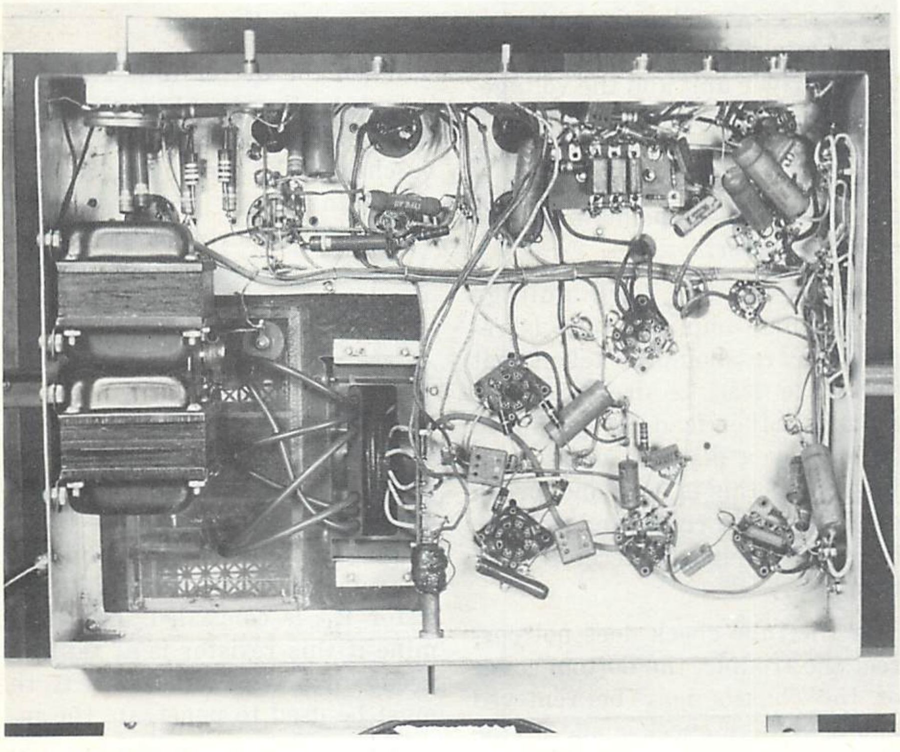
When a pulse type high voltage supply is employed with a cutoff tube like the circuit of Figure 1, trouble in either of the deflection circuits or in the high voltage supply can cause these symptoms. The following check may be employed to determine the faulty section.

With the receiver brightness control set at the extreme counter-clockwise position, tube V_6 is removed from its socket. Next, the picture tube screen is watched carefully while the brightness control is advanced slowly until the screen is just illuminated, or until the full clockwise position is reached with no illumination on the screen. This procedure should be followed with great care because if the beam current becomes excessive at any time, it may quickly damage the picture tube screen materials.

When the above check is made, a vertical line on the screen indicates trouble in the horizontal deflection circuits, and further tests should be made in these circuits to locate the defect. In similar manner, trouble is indicated in the vertical deflection circuits if a horizontal line appears on the screen.

In the event the entire screen becomes illuminated, then the brightness control may be advanced further in an attempt to obtain normal screen brightness. If normal brightness cannot be obtained, the raster has excessive width and height, or if no light can be obtained with the brightness control at maximum setting, the high voltage supply either is not operating properly or the picture tube is defective.

In the high voltage supply circuit of Figure 1, the defect may be located within the sealed can, or it may be in the oscillator or amplifier stages which together are known as the "driver unit". As in any type of television receiver, TESTS OF THE HIGH VOLTAGE SUPPLY SHOULD BE CONDUCTED WITH THE POWER TURNED OFF for safety. However, if the trouble



The underchassis view of the high voltage supply shown in the preceding illustration. Note the heavy insulation of leads and parts used in the high voltage section (lower left).

Courtesy Television Assembly Co.

cannot be located in this manner, it may be necessary to make operating voltage tests.

When trouble in the high voltage supply is indicated, the tubes of the driver unit should be checked by replacing them. The location of these tubes is shown in the drawing of the high voltage supply unit in Figure 2. As shown here, this unit is mounted on a separate chassis and contains only the tubes and circuits of the driver unit and the voltage-multiplier of Figure 1. Not part of the high voltage supply proper, the high voltage cutoff tube circuit is located on the main chassis of the receiver.

Whenever the high voltage driver unit amplifier tube is replaced, care should be taken that the plate lead is dressed away from all other leads or grounded objects by a distance of at least ¼ inch. If this is not done, brush discharge may result and produce interference in the received picture.

If the tube check does not correct the trouble, the bottom cover of the chassis may be removed and a voltage check made at the socket lugs of oscillator tube V_1 and amplifier tube V_2. As shown in Figure 1, the proper operating voltages are given in the schematic diagram or in voltage charts for the different check points in a particular receiver. However, it should be kept in mind that these values represent only the voltages which are present UNDER NORMAL CIRCUMSTANCES; EXTREMELY HIGH VOLTAGES MAY BE PRESENT AT UNEXPECTED POINTS DUE TO ABNORMAL CONDITIONS.

If the voltages are not correct, the power should be turned off and resistance tests made to locate the defective part.

When the driver unit is found to be operating properly, the operation of the sealed can unit may be checked by employing a suitable high voltage probe, insulated test leads, and voltmeter to test the high voltage output. Again, due to the danger involved, EXTREME CAUTION SHOULD BE EXERCISED.

If the high voltage output is low or zero, a defect is indicated, either within the can or in the high voltage lead. Within the high voltage lead and about 2 or 3 inches from the sealed can, filter resistor R_{19} is concealed. To determine if this resistor is at fault, a needle or a clip with sharp teeth must be used to penetrate the insulation between the resistor and the can.

When a high voltage is measured at this point, R_{19} is defective, and should be replaced. If a high voltage is not found at this point, the defect is in the sealed can, and therefore, the whole unit will have to be replaced.

To replace the can, all possibility of circuit operation should be removed by first disconnecting the receiver a-c line cord from the wall receptacle. Next, plate cap P is removed from the amplifier tube, Figure 2, and the 4 leads L unsoldered from the terminals at the top of the sealed can. However, the gland "G" is not unscrewed.

If the bottom cover of the chassis has not been removed previously, it is removed at this time by removing the 4 screws, S, two of which are visible in Figure 2. Finally, loosen the two nuts N, thus releasing clamps C, so that the can may be removed. With the new can in place, clamps C are tightened by means of nuts N, the chassis bottom cover is replaced, and leads L soldered to the terminals on the top of the can. The soldering iron should not be held to these terminals any longer than necessary to make the proper soldered joints.

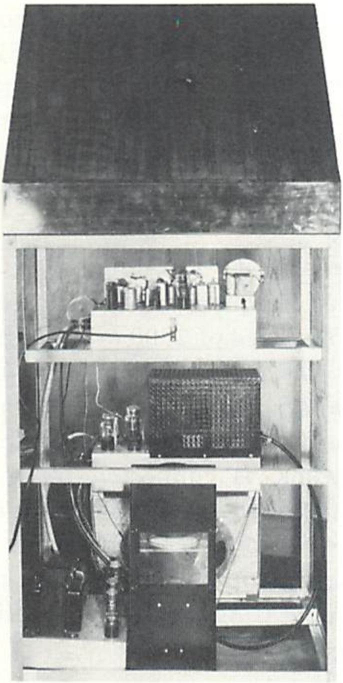
With care, as explained above, the plate cap is replaced on the amplifier tube. Finally, when placing the cover over the high voltage unit, it should be oriented so that the 25 kv lead goes directly up through the cover. Should the lead cross over inside the box, severe arcing may result.

To insure maximum life of the rectifier tubes in the voltage-multiplier circuits, the tube heaters should be operated with the proper currents. Among other things, these currents depend upon the operating frequency of the driver unit, and, as mentioned, the oscillator frequency can be varied somewhat by means of capacitor C_6 in Figure 1. However, C_6 should not be adjusted in an attempt to correct for failures in high voltage supply output voltage or current regulation, since the operating frequency has negligible effect on the regulation.

To adjust the oscillator to the correct frequency, an oscilloscope, and a source of 1000 cycle voltage may be connected to the high voltage supply unit as shown in Figure 3. The resistor R, of about 10 ohms, is connected in series with the red (+350 V) lead, and serves to produce a sufficient a-c voltage drop to provide a signal for operating the scope vertical deflection circuits.

With the 1000 cycle voltage applied to the horizontal input of the CRO, C_6 is adjusted until the Lissajous figure on the screen indicates a frequency ratio of one-to-one. After the oscillator frequency has been set, resistor R should be removed before the high voltage supply is replaced in the receiver.

In the FADA model 880 projection receiver, a high voltage unit like that of Figure 1 is employed, and, in addition to the regular low voltage power supply, an auxiliary power supply furnishes the 350 volts for the plate and screen circuits and 6.3 volts a-c for the heater circuits of the high voltage supply driver unit. Therefore, in an arrangement of this type, a defect in this auxiliary supply could result in reduced brightness, or no light on the screen, even though the regular low voltage supply is operating properly.



The rear view of a projection receiver. The projection tube, lens, and mirrors (lower center) are inclosed in a shield equipped with a viewing window to permit inspection of the tube while in operation.

Courtesy Television Assembly Co.

In the event the various checks mentioned above show the power supplies and deflection circuits, including the high voltage cutoff circuit, to be operating properly, then the operating voltages and circuit components in the picture tube circuit should be tested. If this check does not locate the trouble, the picture tube itself should be checked by replacing it with a new one.

PICTURE TUBE REPLACEMENT

The general arrangement of the picture tube and optical system, which has been used in projection receivers made by RCA, GE, Philco, is shown in Figure 4. In these receivers, the picture tube is mounted with its axis vertical as shown, or at an angle to the vertical.

The light rays travel from the tube face to the spherical mirror which then reflects them through the corrector lens to the flat mirror from which they are reflected to the viewing screen. These paths are indicated by the arrows in Figure 4. Since the viewing screen is translucent, the light passes through it so that the image focused thereon is visible to the observers in front of the screen.

Different clamping arrangements are used to hold the picture tube in place in the various receiver makes, and for each model, the corresponding service manual contains the specific instructions for replacing or installing the picture tube. However, the procedure is nearly the same for all cases, and as an example, here are the procedures for the GE model 901 receiver:

Detach the anode cap and the tube socket. Hold the tube securely in place and use a screwdriver to loosen the screws on the sides of the tube clamp. Spread the clamp open with the blade of the screwdriver, then ease the tube down and out of the clamp and deflection yoke.

Hold the yoke in place and install the new tube from underneath the corrector lens. The deflection yoke textolite sleeve must be kept within the rubber lining on the tube clamp. Pass the tube base through the clamp carefully so the base will not be loosened from the neck.

With the tube rotated so that the anode connector is toward the back of the receiver, tighten the screws to hold the tube firmly in the clamp. Then, attach the anode cap and the tube socket.

The picture tubes employed in these receivers have an insulating coating over the large part of the bulb, as indicated in Figure 4. During humid weather, electric breakdown may occur over this surface due to fingerprints or dust on the coating. Therefore, the insulating coating should not be touched when the tube is handled, and the dust cover should be replaced when service work is completed.

REPLACEMENT OF OPTICAL COMPONENTS

In addition to the picture tube, it is necessary occasionally to replace a damaged viewing screen or other optical system component in a receiver of the type illustrated in Figure 4. Except for the order in which the various components are removed or installed, the procedures are about alike for the various makes and models. The replacement of the optical units for the GE 901 are as follows:

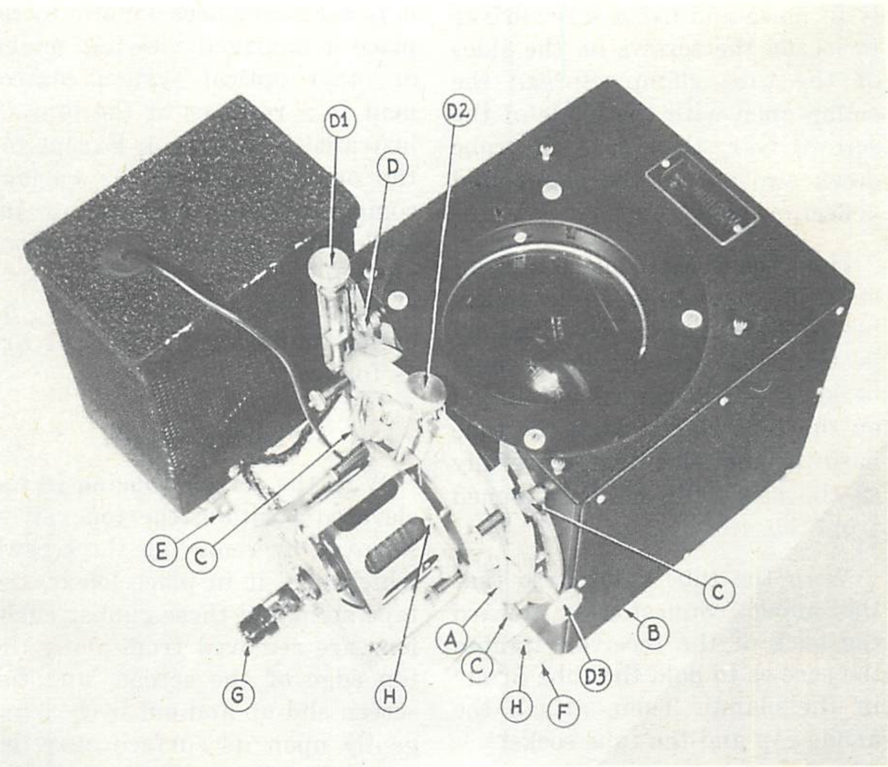
Viewing Screen

With the screen housing in the elevated position, the top rail is removed by removing the screws which hold it in place. Next, the tape strip and three rubber cushions are removed from along the top edge of the screen, and the screen slid up and out by bearing gently upon its surface near the top and center with the palm of the hand.

The new screen is installed by inserting its side edges in the vertical grooves of the housing and sliding it downward using the hand as explained above. The bottom edge of the screen is seated into the grooved recess by tapping GENTLY on the top edge.

The three rubber cushions and tape strip should be replaced, making certain the tape does not cover any of the picture viewing area. Finally, the top rail and holding screws are replaced on the screen housing to complete the assembly.

Whenever the screen is handled, care should be taken that it does not become fingerprinted. In the event it does, it should be cleaned with a piece of cotton slightly dampened with Windex or water. Only a light rubbing action is necessary to clean the screen. It should not be washed with water



Shown is a complete protelgram unit with the high voltage supply. The unit labels are: A—mounting plate, B—optical box, C—tube assembly mounting screws, D—adjustment lock, D_1—adjustment between tube face and spherical mirror, D_2—tube vertical tilt screw, D_3—tube horizontal tilt screw, E and F—units mounting clamps, G—tube socket, H—mechanical centering and focus screws.

Courtesy Scott Radio Lab.

or rubbed hard at any time. Dry cotton or a camel's hair brush may be used to remove dust from the screen.

Flat Mirror

To remove the flat mirror in this receiver, it is necessary to remove the viewing screen first, as outlined above. Then, the screws which hold the flat mirror clamps to the screen housing are removed, after which the mirror can be removed from the receiver. Next, measurements should be made along the edge of the mirror to determine the exact locations of the clamps, and then the clamps removed from the mirror.

The replacement mirror has tissue packing on it, and to prevent fingerprinting the front surface mirror, THE TISSUE SHOULD NOT BE REMOVED UNTIL THE INSTALLATION IS COMPLETED.

A label usually will be found glued to the back of the mirror. However, in the event there is doubt about which is the front, this may be determined by laying the mirror on a flat surface and then carefully approaching the surface of the mirror with an opaque object such as the point of a pencil.

If the image of the object is observed to come into contact with the object at the surface, then this surface is the front of the mirror. On the back surface, a spacing equal to twice the thickness of the glass will be observed between the object and its image.

Using the measurement data obtained earlier, the clamps are fitted to the edge of the new mirror at the proper locations and right over the packing tissue. The mirror now is installed in the receiver by aligning the clamps with the original mounting holes in the screen housing and inserting and tightening the screws. Finally, the tissue packing should be removed from the mirror and the viewing screen replaced.

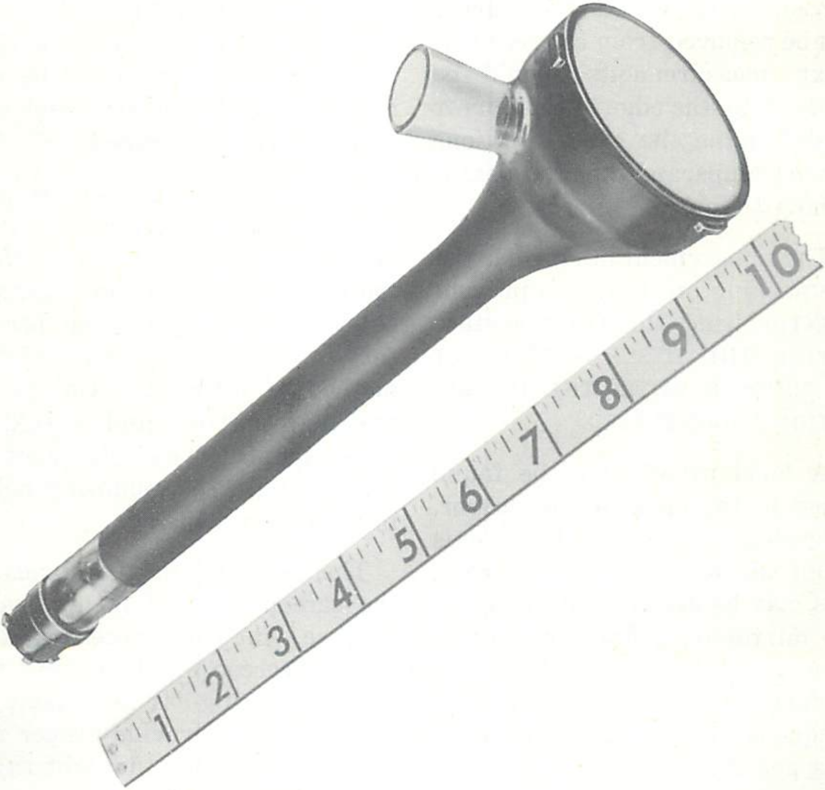
In the event the clamps are loosened on the original mirror, or the mirror is shattered so that the position of the clamps cannot be determined, it is then necessary to employ a cut-and-try method of fitting the clamps to the new mirror and checking their mounting hole alignment to coincide with the mounting holes in the screen housing.

The use of the original holes in the screen housing is necessary because, in each receiver, the original screen was installed with the correct angular alignment at the factory to provide proper reflection angles for the light rays.

Corrector Lens

As shown in Figure 4, the picture tube protrudes through the hole in the center of the correcting lens, and in this receiver the picture tube mounting bracket (not shown) clamps to the tube base above the lens. Therefore, before the lens can be removed, the picture tube must be removed as outlined above, and also the picture tube mounting bracket by removing the screws which secure it to the corrector lens mounting plate. The lens now may be removed by removing the nuts, lock washers, steel washers and fibre washers which hold it in place on the mounting plate.

The new lens should be mounted with the painted edge and concave surface up, and the mounting hardware replaced in the



This projection tube from the protelgram unit is 10" long and has a screen diameter of 3". Note the glass protrusion that insulates the anode connector.

Courtesy North American Philips Co. Inc.

proper order so that the fibre washers make contact with the top edge surface of the lens and are followed in sequence by the steel washers, lock washers, and nuts, respectively. With the lens installed, the picture tube mounting bracket, deflection yoke, and tube may be replaced.

Spherical Mirror

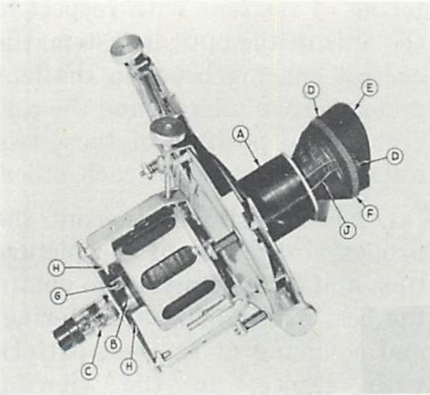
In the GE projection receiver model mentioned, a large mounting plate supports the spherical mirror, and rubber cushioned clamps hold the mirror on the plate. To replace the mirror, it must be supported while the screws and clamps are removed. Then, the mirror can be lifted out of the cabinet. With the replacement mirror mounted carefully, the clamps are replaced, making certain the rubber cushions are between the mirror edge and clamps so that the cushions bear on the mirror edge.

The viewing screen, flat mirror, corrector lens, and spherical mirror all should be handled in such a way as to prevent fingerprinting. However, if they do contain fingerprints or dust, they should be cleaned as explained for the viewing screen. In the case of the spherical mirror, dust may be gently brushed to the center of the black area where it may be picked up with scotch tape.

After any of the above components has been replaced, an operating check should be made by viewing a received picture to determine whether the original alignment has been maintained. In some cases, the system may have become misaligned sufficiently to reduce picture quality seriously, and complete re-alignment is needed.

OPTICAL SYSTEM ALIGNMENT

Because of the different methods of mounting the optical system components in the different makes and models of projection television receivers, the details of the alignment procedures differ considerably, and as with the



The protelgram unit with the optical box removed. The labels are: A—deflection yoke, B—tube clamp, C—tube neck, D—light shield stops, E—light shield, F—rubber band, and J—aquadag ground spring.

Courtesy Scott Radio Lab.

parts replacements, the specific instructions given in the corresponding service manual should be followed for each individual case. To permit the desired alignment, various adjustment nuts and screws are available. In some cases, equipment such as a test lamp and a sighting jig are needed.

In most cases, alignment is necessary only when certain components, such as the picture tube or the corrector lens are replaced. In various receivers, adjustments may be made to obtain the correct angular position of the corrector lens with respect to the flat mirror and screen, the correct centering of the lens with respect to the axis of the optical system, the correct spacing between the lens and spherical mirror, and the correct lateral position of these two units with respect to each other.

Other adjustments permit the proper positioning of the picture tube and deflection yoke to obtain the best over-all focus, centering, and squaring of the test pattern with respect to the viewing screen. In addition to the above, adjustments may be required to position the entire optical unit properly with respect to the receiver cabinet.

SERVICING THE PROTELGRAM UNIT

In general, projection type television receivers fall into two categories: those which employ the basic optical system arrangement shown in Figure 4, and those which use a variation of this arrangement called the Protelgram unit manufactured by North American Philips. A third, smaller group consists of those receivers which contain the refractive type optical system similar to that used in motion picture projectors.

The arrangement of the components of the Protelgram unit is illustrated by the cross-sectional drawing of Figure 5A. Here, the optical components are contained within the optical box on one end of which the focus coil and alignment assembly are mounted and into which the picture tube and deflection yoke are inserted. In addition to the components shown in Figure 5, the complete Protelgram unit includes the high voltage supply illustrated in Figures 1 and 2.

In the unit of Figure 5, the flat mirror contains a hole through which the picture tube bulb protrudes, and the light rays travel from the tube face to the spherical mirror, to the flat mirror, and then through the corrector lens which is shown located above the tube. Leaving the corrector lens, the light rays travel to the viewing screen (not shown), or to another flat mirror, and then reflect to the viewing screen to form the desired enlarged image.

Picture Tube Replacement

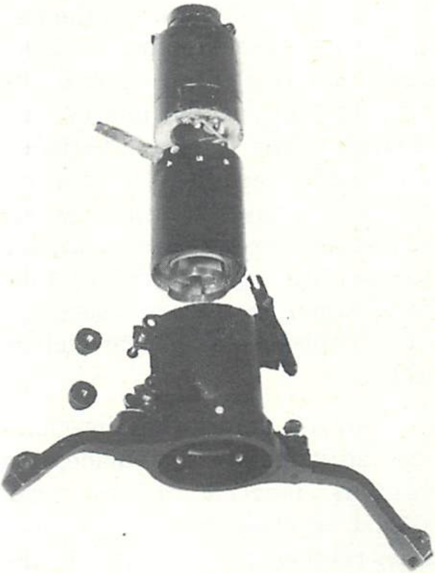
In the assembly of Figure 5A, the picture tube is held in place by means of tube clamp C, and is centered by means of the triangular end plate shown in the assembly rear view of Figure 5B. To replace the tube, the tube socket is removed, nuts M are loosened, and the alignment assembly rotated slightly to the left and then pulled out from the optical box, taking care that the tube does not hit the 45° flat mirror. NEVER hold the assembly by grasping the deflection yoke.

Next, the connector is removed from the anode cup on the picture tube, screws A holding the high voltage cable clamp are loosened, and the cable removed from the clamp. Tube clamp screw C, Figure 5A, and screws T, Figure 5B, holding the triangular end plate are loosened to permit the tube to be pulled forward out of the deflection yoke. Finally, the rubber band and light shield are removed from the bulb of the tube.

With the replacement tube held so that the anode cup is down, the light shield is mounted to shield the screen from above and held in place with the rubber band. The tube is pushed into the deflection yoke and alignment assembly as far as it will go. Then tube clamp screw C is tightened to hold the tube in.

Springs S just press against the tube. These springs may clear or extend under the light shield. Then, the tube is kept centered in the hole in the triangular end plate while screws T are tightened.

The high voltage connector is placed in the anode cup and attached securely to the metal anode button. The cable is inserted in the cable clamp, and with the slack taken up, screws A are tightened.



The deflection and focus coils and mounting bracket used in a theater projection television system.

Courtesy Philco Corp.

The assembly is inserted into the optical box, taking care that the picture tube clears the opening in the flat mirror, the position of the light shield is not disturbed, and the tube does not shift forward from its seating in the deflection yoke. The alignment assembly is rotated to the right until the bottom of the end plate is parallel with the bottom of the optical box, then screws M are tightened. Finally, the tube socket is placed over the end of the tube to complete the installation.

Centering and Focusing Adjustments

In the unit of Figure 5, the picture tube faceplate must be located precisely with respect to the spherical mirror, flat mirror, and corrector lens to obtain satisfactory optical definition on the receiver viewing screen. Several adjusting screws are available for so locating the picture tube face when necessary, such as after replacement of the picture tube.

However, before these mechanical adjustments are made, the various electric adjustments should be made to obtain proper size, centering, and focus of the raster on the picture tube face. After checking to see that all connections are complete, the receiver is tuned to a station which is transmitting a test pattern.

If a test pattern is not available, the raster scanning and retrace lines can be used to check linearity and focus. To make the electric adjustments, the dust cover should be moved aside and the reflected image of the picture tube face observed by looking down through the corrector lens, being careful not to touch the lens.

Never look into the face of a projection tube while the receiver is being operated. At these high voltages, soft X rays which may prove injurious to the technician are generated. By looking at the reflected image through the correction lens, this danger is avoided, since the lens does not pass the X rays.

The receiver size and linearity controls are adjusted to obtain the normal rectangular raster, of proper aspect ratio, which is large enough so that its four corners just touch the edge of the circular tube face. As all four corners cannot be seen from the same position, the position of the eye must be changed so that each corner is viewed separately to make centering adjustments. The focus control is adjusted to obtain the narrowest scanning lines in the raster.

If the image is off-center on the receiver viewing screen so that it does not completely fill the viewing screen frame after the electric adjustments are completed, the mechanical centering adjustments may be made as follows: Loosen the wing nuts which anchor the optical box to the supporting shelf at points F in Figure 5B. Tilt the assembly by hand to correct the picture location on the viewing screen, and note which of tilt screws F must be adjusted.

Hold the optical box free of the shelf at the tilt screws to be adjusted, and make the adjustments by turning the allen-head tilt screws clockwise to jack the box into position. Retighten the wing nuts, and make touch-up centering adjustments by means of the receiver centering controls.

In the event the image is tilted on the viewing screen, screws M may be loosened, and the alignment assembly rotated in the proper direction to correct the condition. When the desired position is obtained, the assembly is secured by tightening screws M.

Indicated in Figure 5B, three thumbscrew adjustments, H, V, and O, are employed to position the picture tube face to obtain proper focusing. Thumbscrews H and V tilt the tube horizontally and vertically, respectively, with the center of the tube face as the center of rotation, while thumbscrew O moves the tube toward or away from the spherical mirror as desired. To make the focusing adjustments, locking nuts L and screws N should first be loosened about one turn each.

Then, in the following order, thumbscrew O is adjusted until the center of the image is properly focused on the receiver viewing screen, thumbscrew H is adjusted until both sides of the picture are focused equally, and thumbscrew V adjusted until the top and bottom are focused equally. Touch up adjustments of all three thumbscrews should be made, with the setting of O rechecked after each slight adjustment of H or V, until the entire picture is brought into satisfactory focus. Tighten the locking nuts L and screws N.

Finally, looking down through the corrector lens as for the electric adjustments, advance the receiver brightness control and note whether the raster is uniformly bright over its entire area. With no picture signal, the raster illumination should remain uniform as the brightness is decreased.

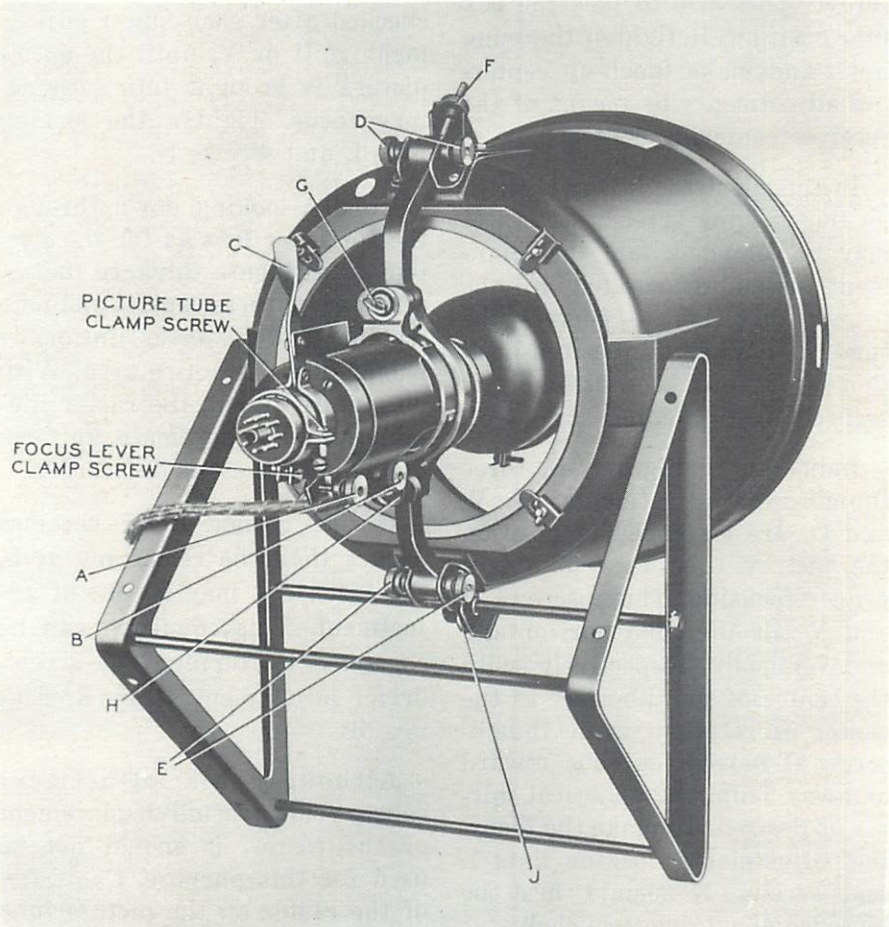
If one corner is or becomes darker than the remaining area, the focus coil may be out of adjustment. This condition can be corrected by turning the screwdriver adjustment screw R, Figure 5B.

Although this adjustment causes some over-all displacement of the raster, it should not be used for this purpose. Centering of the raster on the picture tube face should be accomplished by means of the receiver electric centering controls.

Replacement of Focus Coil

When it is necessary to replace the focus coil in the Protelgram unit, the picture tube should be removed as explained above. Then, referring to Figure 6, screws A are unscrewed and the triangular end plate removed. The cable clamp and mechanical centering adjustment screws B are loosened, snap washers W and spring G removed. The focus coil may be removed from the assembly.

With the new focus coil in place, spring G and washers W are replaced, the cable clamp tightened, and the triangular end plate reassembled. The picture



Projection television system for theaters. The housing holds the picture tube, deflection and focus coils, spherical mirror, and correcting lens.

Courtesy Philco Corp.

tube is installed and the assembly mounted into the optical box as explained previously.

With the Protelgram unit reinstalled in the receiver cabinet, the receiver is switched on and tuned to receive a test pattern. The horizontal and vertical electric centering controls are set to their approximate mid-positions, and the centering adjustment screws B, Figure 6, adjusted until the corners of the test pattern just touch the edge of the picture tube face, as observed by looking down through the corrector lens. When these adjustments are completed, the electric and mechanical centering and focusing adjustments are made as outlined in the preceding section.

Deflection Yoke Replacement

To replace the deflection yoke in the Protelgram unit, the picture tube and focus coil must be removed first as explained above. After carefully noting the mounting position of the yoke to be removed, screws S and the ground lug screw, Figure 7, are removed. Next, the plastic insulating disc is removed, after which the deflection yoke can be removed from the mounting plate. With the new yoke positioned exactly as the original one was, the entire unit is reassembled. Finally, with a test pattern received, the variout centering and focus adjustments are made as explained previously.

Optical Service

With the exception of the picture tube, the components of the optical system within the Protelgram optical box are aligned at the factory, and this box must be returned to the factory for any needed replacement of parts or re-alignment of the mirrors or corrector lens. The optical box is a dust-proof unit, and normally the mirrors inside will not require cleaning.

The top of the corrector lens may be cleaned with a soft cloth. Should it become necessary to clean the mirrors, the side plates of the optical box can be removed and the mirrors dusted with a camel's hair brush and then polished very gently with lens tissue. A spray such as Windex may be used if dirt or discoloration is excessive.

In addition to the components in the optical box, receivers employing the Protelgram unit contain a viewing screen, and in some cases, a second 45° flat mirror, both of which are located outside of the box. When damaged, these external optical units may be replaced as described earlier in this lesson for receivers of the type using the optical arrangement of Figure 4.

Also, as mentioned, these units may be cleaned with a piece of absorbent cotton and a liquid solution of the Windex type. AT NO TIME should the mirrors, lens, or viewing screen in any projection equipment be cleaned with an abrasive cleaning agent such as Bon Ami, Lava Soap, etc.

THEATER TELEVISION EQUIPMENT

Although operating on the same general plan as the home type projection receivers insofar as the optical system is concerned, the television projection equipment employed in theaters must be designed to provide sufficient light output to illuminate satisfactorily a screen large enough to be viewed comfortably by an audience.

In addition, suitable facilities must be available for switching the video circuits to receive signals from either a regular television receiver, microwave relay receiver, or a coaxial cable, and for monitoring the received signals at various points in the system by means of a monitor picture tube and an oscilloscope.

The general layout of the electric equipment employed in the RCA model PT-100 projection system for theaters is shown in Figure 8. As indicated by the dashed lines in the sketch, three different rooms contain the control equipment, projector, and high voltage supply.

In the control room, the signal selector unit permits the selection of the signals from either of two sources, indicated as lines 1 and 2, the control panel contains the sound and picture monitors, oscilloscope, and controls, and the deflection generator provides the horizontal and vertical deflection currents for the projection tube yoke. The power supply block represents a number of supply and voltage regulator units which provide power for the other units in the control room, power room, and projector.

In the projection booth, the projector contains a video amplifier, a projection picture tube of special design to be described, and a reflective optical system (not shown) which is similar to that of Figure 4, but without the flat mirror. Safely located in a room by itself, the high voltage supply provides outputs of 80 kv for the anode and 18 kv for the focusing electrode of the projection tube.

Figure 9 is a sketch of the switching circuits employed in the signal selector unit in the control room. Here, switch S_1 permits connecting either of the two signal sources, lines 1 and 2, to the input of the projector. Switches S_2 and S_3 permit the picture monitor or the oscilloscope to be connected to line 1, line 2, or the output of the v-f amplifier in the projector. Thus, the nature of the received signals can be observed in the control room during the program, or, if desired, before projecting the picture on the theater screen.

In addition to the switching circuits shown in Figure 9, the signal selector unit contains various amplifiers and attenuators, as well as circuits which provide for switching alternative video signal sources to the audio monitor headphones and the regular theater sound system.

The type 7NP4 projection tube employed in the above theater system is shown in the cross-sectional drawing of Figure 10. As indicated, the tube has a face diameter of 7″, this size providing a good balance between light output and the required size of the optical components. The electron gun consists of the indirectly heated cathode, three grids, and the anode which makes conductive contact with a coating on the inside surface of the cone of the tube.

Electrostatic focusing and magnetic deflection are employed, with a deflection angle of 35°. This relatively narrow deflection angle minimizes loss of resolution near the edges of the reproduced image and reduces the deflection power required. This last factor is important because deflection power requirements become greater as the anode operating potential is increased.

A large-screen projection tube. Note the high-voltage connector near the front and the corrugated surface of the bulb.

Courtesy Radio Corporation of America

The required high light output is obtained by employing a high-efficiency aluminized screen and a high-energy electron beam. The screen is made efficient by means of the proper mixture and layer arrangement of phosphors of types capable of converting a high percentage of the electron beam energy into light. As explained previously an aluminum coating increases the total light projected from the front of the tube.

Since the electron beam current is limited by considerations of focusing and energy absorption by the screen, the beam energy is increased by using 80 kv on the anode.

Since the deflection yoke is grounded, and the cathode is operated at or near ground potential, the full 80 kv is applied over half the length of the tube, from the anode contact to the deflection yoke. To prevent leakage along the outside surface of the tube cone between these two points, the path is made long by locating the anode terminal as far forward on the cone as possible and molding corrugations in the outer surface of the cone, as shown in the Figure. In addition, the cone is made longer than usual due to the narrow deflection angle used. Finally, a moisture-repellent, insulating lacquer coating is applied to the outer surface of the cone to prevent the formation of moisture which tends to permit corona and arcing.

To increase the insulation between the deflection yoke and the anode coating on the inner surface of the tube neck, the double-neck arrangement is used as shown. Here, the inner neck carries the anode coating and is inserted into the larger outer neck in such a way that vacuum insulation is provided in the space between the two necks.

To permit bringing the 18 kv lead from the focusing electrode, grid No. 3, out through the tube base, the air is removed from the base and the base filled with a plastic material having high dielectric strength. Finally, a special type of glass is used in the faceplate of the tube to prevent the faceplate from darkening in a short time due to the electron bombardment.

The arrangement of the 7NP4 projection tube and the various optical system components of the RCA theater television unit is shown in Figure 11. Here, the 26 inch spherical mirror is located a distance of 30 inches from the correcting lens which, as indicated, has a useful or working diameter of 21½ inches. The entire optical system is designed to focus the image on a standard 15 by 20 foot viewing screen located a distance of 60 feet from the correcting lens.

During normal operation, from 80 to 160 watts is dissipated on the faceplate of the projection tube. Unless cooling other than that caused by convection and radiation is provided, the heat generated will reduce the efficiency of the luminescent screen and possibly cause the faceplate to fracture. Therefore, the faceplate temperature is maintained below the recommended maximum value of 100° C by directing upon it a stream of air from a small blower through a hole in the center of the spherical mirror, as shown in Figure 11.

X-RAY RADIATION

Because of the high anode voltages employed in the various projection type picture tubes, the scanning beam electrons bombard the inner surface of the faceplate with sufficient force to produce penetrating X rays.

For example, the X-ray radiation intensity in various directions from the faceplate of the type 7NP4 tube is shown in the polar graph of Figure 12. As indicated, intensity is measured in roentgens per hour per milliampere, the roentgen being the international standard unit of quantity of X rays.

Although commercial X-ray tubes provide intensities much higher than the values indicated by the curve of Figure 12, the radiation levels of the television projection tubes are many times higher than is safe for continuous exposure at close range. Therefore the tubes are shielded by enclosing the entire optical system in a metal "barrel". As indicated in Figure 11, the correcting lens is made of a type of glass which absorbs X rays but allows light to pass.

In the Protelgram unit of Figure 5, the X-ray radiation is confined by the optical box and, as recommended by the manufacturer, the picture tube should be operated only when it is inside the box. However, in the event it is necessary to operate the tube outside the box, the observer should be protected by means of a lead glass shield placed in front of the tube face when it is necessary that the observer be within 40 inches of the tube.

This shield should have dimensions such that it will interrupt the X rays between the tube and observer, and should have an equivalent lead thickness of not less than 0.5 mm. In the case of the projection receivers using the optical arrangement of Figure 4, similar precautions should be employed when it is necessary to operate the picture tube outside the protective metal barrel.

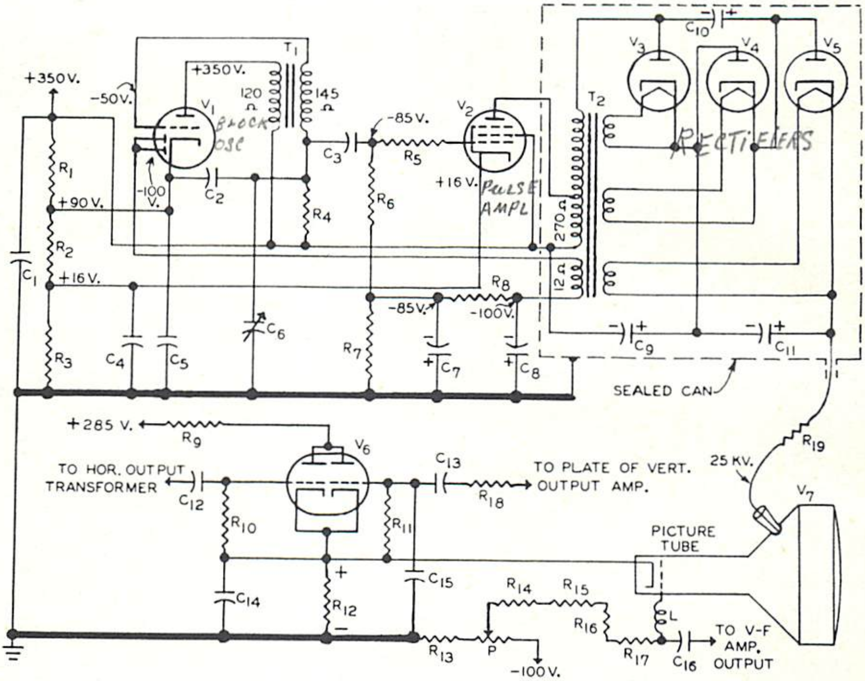


FIGURE 1

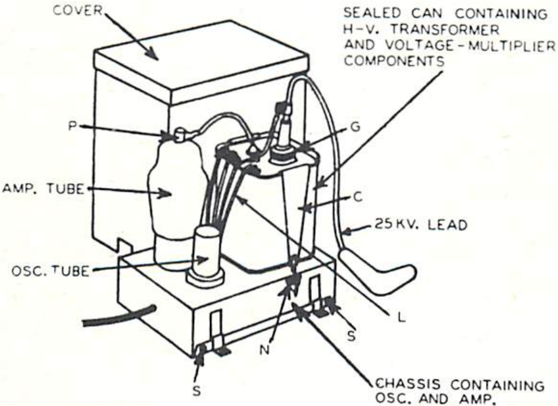

COVER
SEALED CAN CONTAINING H-V. TRANSFORMER AND VOLTAGE-MULTIPLIER COMPONENTS
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FIGURE 2

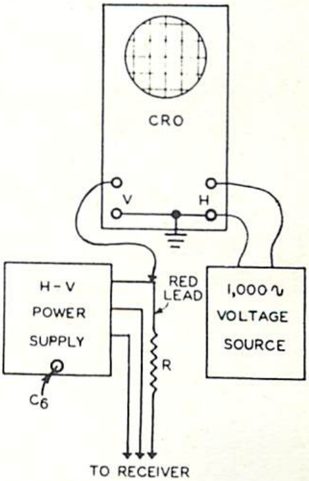

FIGURE 3

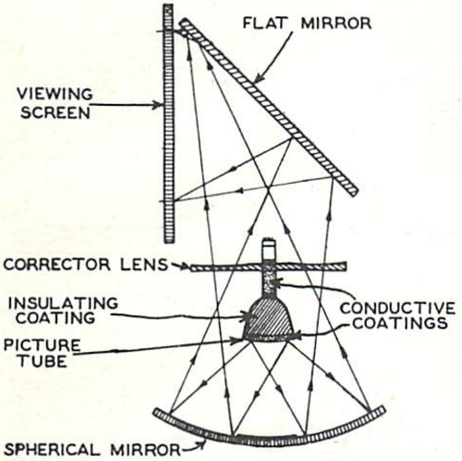

FIGURE 4

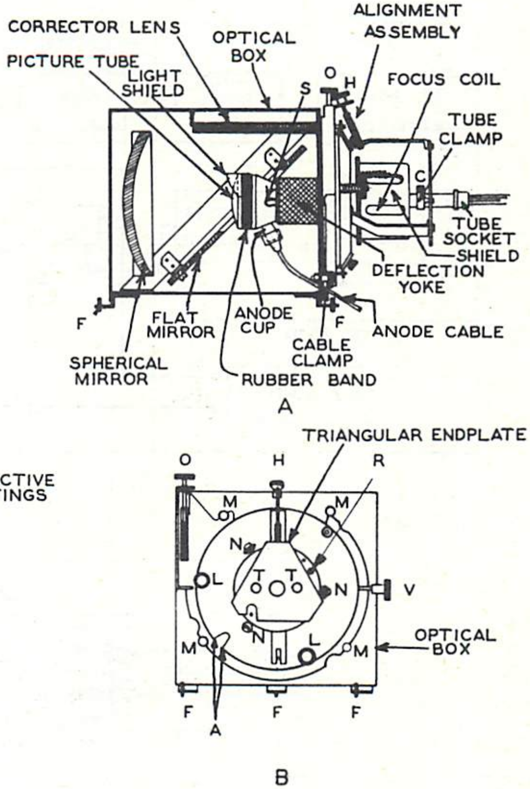

FIGURE 5

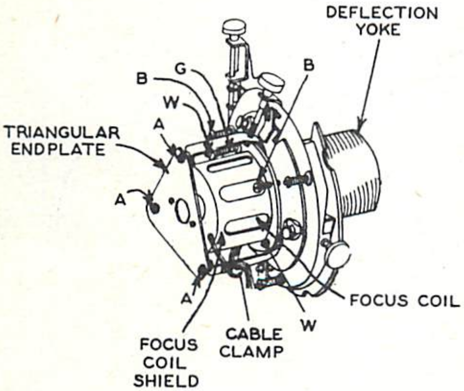

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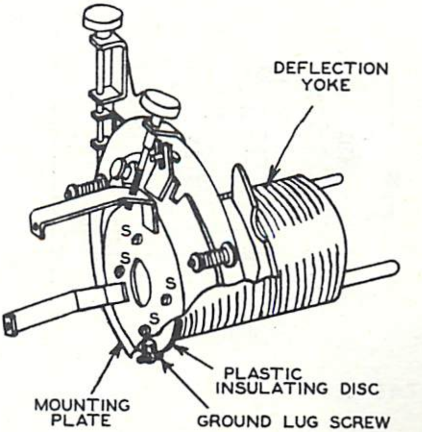
FIGURE 6



COURTESY NORTH AMERICAN PHILIPS CO.,INC.

FIGURE 7

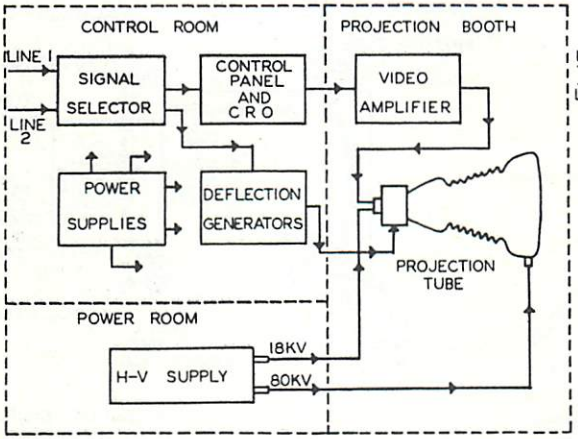


FIGURE 8

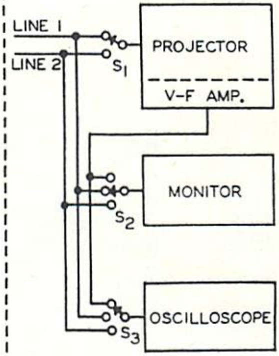
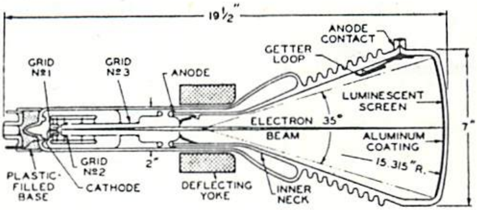
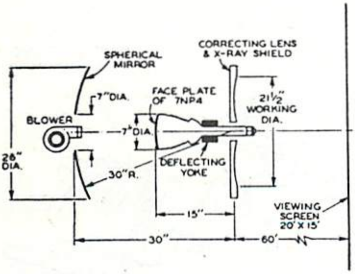


FIGURE 9



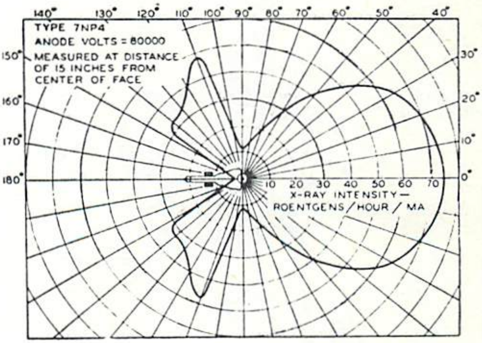
COURTESY RCA

FIGURE 10



COURTESY RCA

FIGURE 11



COURTESY RCA

FIGURE 12

FROM OUR *Director's* NOTEBOOK

REACHING THE RIGHT MAN

How many times have you tried to reach someone by telephone in a large company—someone you knew could help you—if only you knew which one he was?

You probably get transferred from department to department, from person to person—and after considerable effort and repeats of your request, you may get the right person.

Now what if you went about applying for a job in the same manner? You'd be behind the eight ball in short order, wouldn't you?

Contrast this trial and error method with a readily available, everyday service that opens the door to the correct person the first time—Uncle Sam's mail system.

Yes, a good letter addressed to the Personnel Manager—giving a full outline of your qualifications . . . one that tells your story in an interesting and complete way — may pay many times more dividends than a telephone call asking if the company "is hiring these days."

Try it.

Yours for success,

W. C. De Vry

DIRECTOR

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